

M1.(a) any **one** from:

- solution becomes colourless or colour fades
- zinc becomes bronze / copper coloured
allow copper (forms) or a solid (forms)
- zinc gets smaller
allow zinc dissolves
- bubbles or fizzing.
ignore precipitate

1

(b) improvement:

use a plastic / polystyrene cup or add a lid

accept use lagging / insulation

1

reason - must be linked

reduce / stop heat loss

OR

improvement:

use a digital thermometer

allow use a data logger

reason - must be linked

more accurate or easy to read or stores data

allow more precise or more sensitive

ignore more reliable

ignore improvements to method, eg take more readings

1

(c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1–2 marks)

There is a statement about the results.

Level 2 (3–4 marks)

There are statements about the results. These statements may be linked or may include data.

Level 3 (5–6 marks)

There are statements about the results with at least one link and an attempt at an explanation.

Examples of chemistry points made in the response:

Description:**Statements**

Concentration of copper sulfate increases

Temperature change increases

There is an anomalous result

The temperature change levels off

Reaction is exothermic

Linked Statements

Temperature change increases as concentration of copper sulfate increases

The temperature change increases, and then remains constant

After experiment 7 the temperature change remains constant

Statements including data

The trend changes at experiment 7

Experiment 3 is anomalous

Attempted Explanation

Temperature change increases because rate increases

Temperature change levels off because the reaction is complete

Explanation

As more copper sulfate reacts, more heat energy is given off

Once copper sulfate is in excess, no further heat energy produced

6

[9]

M2.(a) any **three** from:

- concentration of (salt) solution
- volume of (salt) solution
ignore amount of solution
- **initial** temperature (of the solution)
ignore room temperature
- surface area / form of metal
- moles of metal
allow mass / amount
ignore time
ignore size of tube

3

(b) 20

1

32

1

12

allow ecf

1

- (c) (i) four bars of correct height
tolerance is +/- half square
3 correct for 1 mark

2

bars labelled

1

- (ii) *one variable* is non-continuous / categoric
accept qualitative or discrete

accept no values between the metals

1

(iii) magnesium

1

because biggest temperature change

accept gives out most energy

ignore rate of reaction

dependent on first mark

1

(iv) does not react / silver cannot displace copper

1

because silver not more reactive (than copper) **or** silver below copper in reactivity series

*do **not** accept silver is less reactive than copper sulfate*

1

(v) replace the copper sulfate

could be implied

1

with any compound of a named metal less reactive than copper

allow students to score even if use an insoluble salt

1

[16]

M3.(a) any **two** from:

- copper / ores are running out / harder to find
- there are no / very small amounts of high-grade copper ores left
- copper metal is in demand
- copper is expensive
- now economical to extract copper from low-grade ores
it = copper
allow new methods of extraction e.g. bioleaching and phytomining
allow high-grade ores are running out for 2 marks

2

- (b) (i) large amounts / 98% of rock to dispose of as waste
accept contains toxic (metal) compounds / bioleacher
- or**waste rock takes up a lot of space

1

- (ii) (copper sulfide reacts with oxygen to) produce sulfur dioxide / SO_2
allow (sulfur reacts with oxygen to) produce sulfur dioxide / SO_2

1

that causes acid rain

*allow description of effects of acid rain **or** sulfur dioxide*
*if no other mark awarded allow CO_2 produced which causes global warming **or** CO_2 produced by burning fuel or heating the furnace*
for 1 mark

1

(iii) any **one** from:

- large amounts of fuels / energy used (for the furnace and electrolysis)
allow large amounts of electricity needed
ignore high temperature / electrolysis unqualified
- (the extraction has) many steps / stages / processes
allow (extraction) is a long process / takes a lot of time

- large amounts of ore / material have to be mined
allow ores contain a low percentage of copper

1

(iv) (copper ions move towards) the negative electrode / *cathode*

1

because copper ions / Cu^{2+} are positively charged **or** are oppositely charged **or**
copper ions need to gain electrons

*allow because metal ions are positive **or** opposites attract*

1

(v) (growing) plants

1

[9]

M4.(a) (i) hydrogen

accept H₂

allow H

1

(ii) hydroxide

accept OH⁻

allow OH

do not accept lithium hydroxide

1

(b) any **two** from:

'it' = potassium

potassium:

accept converse for lithium

- *reacts / dissolves faster*
allow reacts more vigorously / quickly / violently / explodesignore
reacts more
- *bubbles / fizzes faster*
allow fizzes more
allow more gas
- *moves faster (on the surface)*
allow moves more
- *melts*
allow forms a sphere
- *produces (lilac / purple) flame*
allow catches fire / ignites
do not accept other colours

2

[4]

- M5.** (a) (i) *reduction*
accept redox / smelting 1
- (ii) 3 4 3 1
- (b) (i) 55
ignore other units
- (ii) Water
accept sodium hydroxide
accept correct formulae H₂O or NaOH 1
- (iii) any **one** from:
 - save energy / fuel for transporting the ore
accept less (cost of) transport allow transported quickly
 - (old) quarries nearby for waste/red mud 1
- (c) **Environmental**
any **one** from:
 - less mining / quarrying (of bauxite)
allow loss of habitat / less qualified noise pollution
 - less landfill space needed / used
allow less red mud / waste
 - less use of fossil fuels / energy
 - less carbon dioxide produced 1

Ethical or social

any **one** from:

- saves resources
allow using resources more than once
- creates (local) employment
if answers reversed and both correct award 1 mark
- more people aware of the need for recycling
allow less qualified noise pollution if not given in environmental

1

[7]

- M6.** (a) any **one** from:
- no method / electrolysis / equipment / technology
allow 'didn't know how to' or 'no knowledge'
 - aluminium is a very reactive metal
 - high melting point
allow 'couldn't heat it enough'
 - potassium had not been discovered
- 1**
- (b) because others / scientists / they could not repeat the experiment
ignore he could not repeat the experiment
- or**
others / they could not obtain the same results
- 1**
- (c) reaction is endothermic **or**
reaction takes in heat / energy
accept activation energy
ignore rate / high temperature
ignore bonds broken
- 1**
- (d) (aluminium chloride + potassium) → aluminium + potassium chloride
in either order
accept correct formulae
ignore metal
ignore balancing
- 1**
- (e) when tested it had the properties of a metal
accept a test for a metal property eg conductivity / reaction with acid
- 1**

properties were different (from other known metals)
accept properties compared with other metals

1

[6]

M7. (a) (i) contains enough metal to make it economical to extract 1

(ii) Fe (+) CO₂
formula of both products must be correct 1

(Fe₂O₃) (+)3....(CO)
→
.....2.....(Fe) (+)3...(CO₂)
balancing correct
allow correct balancing using Fe₂ 1

(iii) reduction
accept redox 1

(b) (i) oxygen reacts with the carbon to produce carbon dioxide
allow carbon monoxide for carbon dioxide 1

OR

carbon dioxide is produced (1)
which escapes as a gas (1) 1

(ii) to give steels with different / particular properties or for
different / particular uses
ignore to make different alloys 1

(c) copper is very expensive

accept the metal (iron / steel) costs less than copper

ignore energy

1

because copper ores are 'low grade' / running out

allow copper is rare

ignore nickel

1

[9]